

THE DISTRIBUTION OF THE MEDITERRANEAN SNAIL, *THEBA PISANA* (MOLLUSCA : HELICIDAE), ON ROTTNESST ISLAND, WESTERN AUSTRALIA.

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ABSTRACT

The spatial distribution of *Theba pisana* on Rottnest Island has changed considerably since its introduction around 1925. Several new colonies have become established and others have become extinct since the last survey in 1978 by Johnson and Black. In 1978 *Theba* occupied a total area of 5.81 km² which expanded to 7.24 km² sometime before this survey in which it was found that the snail occupies only 2.08 km². The total extent of *Theba* has declined to 35% of the area occupied in 1978.

INTRODUCTION

The Mediterranean Snail *Theba pisana* was introduced on Rottnest Island in the vicinity of the Thompson Bay settlement between 1925 and 1927. Surveys in 1936, 1947, 1958 and 1978 (Serventy 1949, Serventy and Storr 1959, Johnson and Black 1978) have investigated the expansion of the initial colony and the establishment of isolated colonies at the Lighthouse, Cape Vlamingh, Stark Bay, Conical Hill and The Bluff. This study documents the distribution of *Theba pisana* on Rottnest Island in May and August 1988 and examines the changes since 1978.

CENSUS METHOD

Distribution was determined by walking several transects (approximately 10-15m apart), within the area of each known colony, with cross transects to find the boundaries of areas occupied by live and dead animals. Areas between colonies were censused by several transects. The distance between these transects varied with the distance between colonies, those closer together were sampled more intensively (every 5m) than those further apart (every 20-30m). In this way most of the island was covered.

A complete survey was impossible in the time available in May, so the survey was completed in a second trip in August. Several boundaries described during the first part of the survey were checked in the second visit and found to be little altered (less than 3m change). Most of the island was surveyed by the author in the two trips, with occasional assistance from others.

The searches were carried out throughout the day, from early morning to evening and once or twice at night. Thus some information was obtained on the variability in activity and observability of *Theba* during the day and under various weather conditions which ranged from sunny through to heavy rain, sometimes within a day.

PRESENT DISTRIBUTION

The present distribution of *Theba* on Rottnest Island is examined from west to east. Those colonies which may have originated from the same

initial colony, as shown in Figure 1 (Serventy and Storr 1959) are discussed together. Changes in the boundaries since 1978 (Johnson and Black 1978) as evidenced by dead shells, and present live colonies are compared in Figure 2. The numbers represent locations mentioned when describing the present distribution.

The colonies at Cape Vlamingh, Stark Bay and Conical Hill remain isolated. The Cape Vlamingh colony has retracted westward and is now found extending between Eagle Bay and Radar Hill. The Conical Hill colony had expanded slightly westward and southward but has since suffered extinction, leaving only a small extant colony on the southeast face of a dune to the south of Conical Hill. The Stark Bay colony has continued to expand to the southeast, near White Hill, but has died back elsewhere, leaving a remnant on either side of the bitumen road.



Figure 1. Map of Rottneet Island showing the progressive colonisation of *Theba pisana* from 1936 to 1958.

The Lighthouse colony had extended slightly in most directions, and subsequently retracted considerably, leaving several small extant colonies. The isolated colony near Ricey Beach is presumably a relict of this expansion and subsequent retraction, as is the colony near the lighthouse road turnoff. The occupied area now extends to Barkers Swamp in the north, and along several tracks to the northwest. Only dead shells were found at the site of the Pink Lake extension of 1978 and also in the area to the southwest near Lighthouse Swamp. The limit of distribution directly south of the lighthouse has remained stable.

The colony near Salmon Swamp appears to be a relict of expansion from the colony west of Gun Hill. The area south of Gun Hill has not been recolonised since the 1978 survey. The colony at The Bluff remains isolated, though it has extended to the northwest.



Figure 2. Map of the distribution of *Theba pisana* on Rottne Island showing the boundaries of distribution of living snails in 1978 and 1988 and the maximal area covered by snails between the two censuses as judged by the presence of shells. The numbers on the map refer to locations listed below and mentioned in the text.

- | | | |
|---------------------|---------------------------|----------------------------|
| 1 Cape Vlamingh | 12 Salmon Swamp | 23 Bathurst Point |
| 2 Stark Bay | 13 Gun Hill | 24 Rifle Range Swamp |
| 3 Conical Hill | 14 The Bluff | 25 Herschell Lake |
| 4 Eagle Bay | 15 Rubbish Tip | 26 Garden Lake |
| 5 Radar Hill | 16 Bagdad Lake | 27 Thompson Bay Settlement |
| 6 White Hill | 17 Point Clune | 28 Barracks |
| 7 Lighthouse | 18 Parakeet Swamp | 29 Bickley Swamp |
| 8 Ricey Beach | 19 Geordie Bay Settlement | 30 Government House Lake |
| 9 Barkers Swamp | 20 Padbury's Flats | 31 Porpoise Bay |
| 10 Pink Lake | 21 Mt Herschall | 32 Henrietta Rocks |
| 11 Lighthouse Swamp | 22 Longreach Bay | |

Between the lakes there has been a retraction to the east, leaving only a small extant colony around the rubbish tip and fields to the south of Lake Bagdad. There has been no further expansion at Point Clune, and the Parakeet Swamp extension has retracted eastward towards the Geordie Bay Settlement, leaving scattered extant colonies on Padbury Flats and Mt Herschell.

Colonies in the area from Longreach Bay to south of Bathurst Point have retracted to a small isolated colony at Rifle Range Swamp and another larger colony between Herschell and Garden Lakes.

Only a few scattered *Theba* were found near the public showers in the Thompson Bay Settlement, which was thought to extend to the southeastern shore of the island, incorporating the now isolated Barracks colony at Bickley Bay. Because of the lack of dead shells, the snails probably have not been in the intervening area for some years except in the area immediately around the Barracks. This area was not surveyed in 1978 because only boundaries where expansion could take place were examined (Black pers comm.) and is therefore not included in the 1978 data listed in Table 1.

The colony south of Government House Lake has extended westward near the airstrip but has retracted northward from Porpoise Bay to a narrow band

extending east up to Bickley Swamp. Between Henrietta Rocks and the Barracks no shells were found except for a narrow strip next to the road.

Table 1 summarises the changes in distribution between 1978 and 1988 for nine colonies of snails. As judged by the presence of dead snails found beyond the boundaries of the 1978 distribution, all the colonies increased in area sometime between 1978 and 1988, including two small areas not found in 1978. In total, the extension beyond 1978 boundaries of distribution increased the area by 125%. The total area occupied by living snails in May and August 1988 is only 36% of the area in 1978 and only 29% of the maximal area covered between 1978 and 1988. Each of the nine colonies have recently decreased in area so the decline in distributional area has occurred over the entire island.

Table 1. Areas occupied by colonies of *Theba pisana* on Rottnest Island between 1978 and 1988. The map reference numbers refer to locations indicated on Figure 1, and the — indicates colonies that did not exist in 1978.

Colony (map reference number)	Area in km ²		
	1978	Maximum 1978-1988	1988
Cape Vlamingh (1)	0.22	0.28	0.12
Conical Hill (3)	0.06	0.10	0.001
Stark Bay (2)	0.24	0.35	0.08
Ricey Beach (18)	—	0.12	0.06
Lighthouse (7)	2.41	2.93	0.83
Salmon Swamp (12)	—	0.02	0.01
The Bluff (14)	0.04	0.07	0.04
East (16-32)	2.84	3.29	0.92
Barracks (28)	—	0.08	0.02
Total	5.81	7.24	2.08

DETERMINANTS OF DISTRIBUTION

Johnson and Black (1978) observed that *Theba* was most common in stands of *Acanthocarpus preissi* and associated plant species. The areas of expansion from the Lighthouse and Stark Bay in 1978 were covered primarily with these plants.

A similar plant/snail association was observed in this study, with *Theba* occurring mainly on *Acanthocarpus* at Cape Vlamingh and Stark Bay. A number of *Theba* were found in a dense stand of sedge and *Acanthocarpus* to the south of Eagle Bay. The colony at Conical Hill was between two stands of *Acacia* sp. on the southeastern duneface. Active *Theba* were observed on *Acacia* stems and leaves and also on the ground, on a small herb. This may be due to the presence of a good ground vegetation cover and moist conditions between the *Acacia* stands. Nowhere else was *Theba* observed on *Acacia*, or in mature plantations with much shade and little ground vegetation, as in the plantations to the west and east of the lighthouse.

The boundary of *Theba* south of the lighthouse, where there is an abrupt change from *Acanthocarpus* to *Olearia axillaris*, has remained stable since 1958 (Johnson and Black 1978). *Theba* has still not successfully colonised *Olearia* stands to the east of the lighthouse, near Bulldozer Swamp, or in the centre of Point Clune. Several individuals (5-10) were observed in *Olearia* stands south of Government House Lake, but it is not known whether they were residents or moving elsewhere.

Colreavy (1977) found that *Theba* readily ate *Olearia* leaves, and Black and Johnson (1978) observed that *Olearia* bushes at the western edge of the Conical Hill colony were the preferred resting sites of adults. It seems therefore, that *Theba* does not have an aversion to *Olearia* itself.

During this survey, it was noticed that many of the *Olearia* bushes around Cape Vlamingh, and to the east of the lighthouse, have an 'Ant-honeydew producing Homopoteran association'. This type of association is fairly common (Way 1963, CSIRO 1970). The aggressive behaviour of the ants prevent harmful insects from attacking the plant or Homopoteran. However the bushes south of Government House Lake where snails were found do not have this association. Therefore it is possible that the ants are preventing *Theba* from successfully colonising *Olearia* stands at Cape Vlamingh and east of the Lighthouse.

Johnson and Black (1978) predicted that by 1988, the Stark Bay and Lighthouse colonies would fuse. The boundaries of these two colonies have in fact remained separate and relatively unchanged even though the vegetation in between is the preferred *Acanthocarpus*. The vegetation is however, very low (<15cm), and sparse with sand in between the bushes and with little undergrowth. There are few high points to which *Theba* could climb to aestivate (Boswell, 1974) or escape predators such as the Bobtail lizard *Tiliqua rugosa* (Colreavy, 1977). Another reason for the unchanged boundaries may be that *Theba* was and is relatively sparse in this area.

During the course of this survey, live *Theba* were observed to be fairly sparse over most areas of its distribution. *Theba* densities were greater in the dips and hollows between dunes, and also on the dune face away from the prevailing winds (generally the eastern face). This was especially noticeable in the Conical Hill and Padbury Flats areas, where scattered groups of live snails could be found only on one face of the dunes.

The activity level of *Theba* varied with light intensity (more were active in the late afternoon and at night, or early morning), and moisture (more snails were observed and were active during or just after a period of rainfall). Several snails were marked in the area near the lighthouse and observed every three hours in order to get some idea of how far they would travel. At night it was found that some snails moved up to 4m in three hours, while during the day most remained in one place or moved less than 50cm. If it was raining the snails were more active. The boundaries of distribution of live snails is therefore a little fluid.

Most of the animals observed during the day (not raining), had intact

epiphragms, but even the inactive animals observed towards the end of the day or early in the morning did not. Boswell (1974) observed that *Theba* can enter into and exit from aestivation rapidly, and it would appear that those individuals observed during this survey were utilising this ability on a daily basis.

Perry (1978) found that *Theba* was very sparse, even where it was once abundant. The Rottnest Island population appears to have suffered another decline in the period before the 1988 survey, with most boundaries retracting from those observed in 1978 by Johnson and Black. As Johnson and Black (1978) only examined boundaries where expansion could take place, their estimate of total area occupied by *Theba* in 1978 was probably an overestimate. However, as the total area occupied by living snails in May and August 1988 was approximately a third of the area in 1978 and only 29% of the maximal area covered between 1978 and 1988, this population has still suffered a distinct decline in area.

Serventy and Storr (1959) felt that *Theba* would accomplish the colonisation of the entire island within a short time as judged by the rapidity of the spread. However this hasn't happened, and not enough is known about factors affecting the snail to provide an explanation. Fluctuations of populations have been recorded elsewhere (Krebs 1978), and it would be interesting to monitor the population of *Theba pisana* on Rottnest Island and to determine whether periodic fluctuations occur over long time periods and perhaps a cause.

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REFERENCES

- BOSWELL, W. 1974. Aestivation and survival in 3 terrestrial pulmonate snails. Hons. Thesis, Zoology Dept., University of W.A.
- COLREAVY, M. 1977. Factors controlling the distribution of *Theba pisana* (Muller). BSc Hons. Thesis, Univ. W.A.
- JOHNSON, M.S., and BLACK, R. 1978. The distribution of *Theba pisana* on Rottnest Island. West. Aust. Nat., 14: 140-143.
- KREBS, C.J. 1978. Ecology, The experimental analysis of distribution and abundance. 2nd ed., Harper and Row.
- CSIRO, 1970. The Insects of Australia. Melbourne University Press.
- PERRY, D.H. 1978. The Mediterranean snail (*Theba pisana*) on Rottnest Island. West. Aust. Nat., 14: 24-25.
- SERVENTY, D.L., and STORR, G.M. 1959. The spread of the Mediterranean snail on Rottnest Island — Part II. West. Aust. Nat., 6: 193-196.